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Multimedia Database: Content and Structure

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Abstract

Multimedia is a combination of text, graphics, animations, audio and video converted from different formats into digital media. The extension of database application to handle multimedia objects requires synchronization of multiple media data streams. Time-related characteristics of multimedia data should be superimposed on the existing database. This paper will try to focus on several aspects of multimedia databases- its need, structure and method of handling multimedia components in order to render multimedia services to its users.

1 Introduction

Everyone deals with multimedia at every walk of lives. We work with multimedia and are surrounded by multimedia. Due to the advancement of modern computer and information technology, multimedia systems play more and more impact on our lives. Therefore, it is more challenging fact how to organize and structure these huge multimedia information so that we can get information easily at any point of time. To do so, multimedia database is a tool required to manage and maintain huge multimedia objects. Multimedia objects consist of texts, graphics, animations, video, sounds, music etc. Multimedia applications often address file management interfaces at different levels of abstraction such as hypertext application, audio editor, audio-video distribution service depending on the real strength of multimedia database and its structure.

2 Multimedia database management

Multimedia database is a kind of database like any other databases containing multimedia collections. Multimedia is defined as the combination of more than one media, they may be of two types--static and dynamic media. Text, graphics, and images are categorized as static media; on the other hand, objects like- animation, music, audio, speech, video are categorized as dynamic media. Graphic images may consist of cliparts, photographs, logos, and custom drawings. Sound consists of voice narration, speech, music etc. Video data encompasses sound as well as photos. To manage these data multimedia database management system is essential. Multimedia database management system can be defined as a software system that manages a collection of multimedia data and provides access to users to query and retrieve multimedia objects. Generally, multimedia database contains text, image, animation, video, audio, movie sound etc. But, all data are stored in the database in binary form.

3 Why multimedia databases?

Following arguments will try to justify the requirements of multimedia database as explained below:

- Multimedia Database is capable of handling huge volume of multimedia objects which a general database fails to do effectively;
- Multimedia Database will help to create virtual museum;
- It will surely help to develop multimedia applications in various fields like teaching, medical sciences and libraries;
- Preserving decaying photographs, maps, films having got historical evidence or national importance;
- Using multimedia database, we can develop the excellent teaching packages;
- Helps multi-user operations.

4 Multimedia database: types

There are generally two types of multimedia databases: Linked Multimedia Databases and Embedded Multimedia Databases.

4.1 Linked multimedia databases

Multimedia database can be organized as a database of metadata. This metadata links to the actual data such as graphic, image, animation, audio, sound etc. These data may store on Hard Disc, CD-ROM, DVD or Online. In this database, multimedia elements are organized as image, audio/ MP3, video etc.

In this multimedia database system, all data may be stored either on off-line i.e. CD-ROM, Hard Disc, DVD etc. or on Online. One great advantage of this type of database is that the size of database will be small due to the reason that multimedia elements are not embedded in the database, but only linked to it.

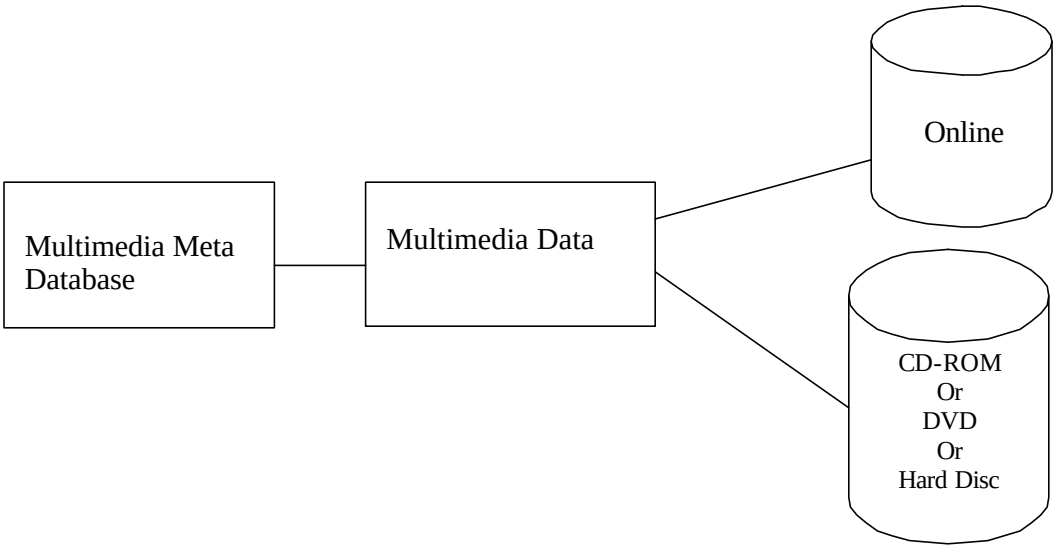

Fig.1: Multimedia Linked Meta Database

4.2 Embedded multimedia database

Embedded Multimedia Database implies that the database itself contains the multimedia objects as in the binary form in the database. The main advantage of such kind of database is that retrieval of data will be faster because of the reduced data access time. However, the size of the database will be very large.

5 Characteristics of MDBMS

A MDBMS (Multimedia Database Management System) can be characterized based on its objectives at the time of handling multimedia objects:

- Corresponding storage media
- Comprehensive search methods
- Device and format Independence Interface
- Simultaneous data access
- Management of large amount of data
- Relational consistency of Data Management
- Long Transaction

The design of a multimedia database management system is unlikely to follow in the footsteps of the design of a traditional database management systems due to the following characteristics of multimedia objects:

- Multimedia are complex and therefore less completely captured in a MBDMS;
- Multimedia objects are audiovisual in nature;
- Multimedia objects are context dependence;
- Queries looking for multimedia objects are fuzzy in nature.

6 Prerequisites for MDBMS

6.1 Synchronization

Multimedia data refers to the simultaneous use of data in different media forms, including images audio, texts and numerical data. Many multimedia applications such as recordings and playback of motion video, video conferencing and slide presentations require continuous presentations of media data streams. Such synchronization requirements are specified by either spatial or temporal relationship among multiple data streams. For example, a motion video and its caption must be synchronized spatially at the appropriate position in a movie, and in a slide presentation, a sequence of images and speech fragmentation must be temporally combined and presented to compose unified and meaningful datastreams. Current database systems are not equipped to represent the entire multimedia data-flow. There are generally two main types of synchronization: Intra-synchronization and Inter-synchronization

6.1.1 Intra-synchronization

In order to represent the original data stream to users, synchronization constraints among media objects must be specified and maintained. Such synchronization is called Intra-synchronization.

6.1.2 Inter-synchronization:

If the data stream is composed of media objects from different media streams, additional complications may arise with the timing relationships. Such media data streams may not be merged prior to storage in a database. Thus, the synchronization of multiple media data streams is known as Inter-synchronization, which becomes an essential prerequisite to any successful multimedia database application. For this reason, synchronization is one the important factors that should be taken into consideration in order to provide multimedia applications.

6.2 Time dimension

Multimedia data stream consists of a set of data upon which some time constraints are imposed. The time constraints may specify discrete, continuous, step-wise constant time flow relationship among the data. For example, some multimedia streams such as audio and video are continuous in nature, in that they flow across time; other data stream such as slide presentation and animations have discrete or step-wise constraints. Therefore, multimedia streams may not have convenient boundaries for data presentation.

7 Multimedia database content

Multimedia Database generally holds the following multimedia components like--text, graphics, animation, sounds, video etc.

7.1 Text

In multimedia applications, text is being used. Reason is that a longer text reading is difficult by the smaller screen resolution. At the same time, when a piece of information fails to communicate to others using other multimedia elements, text is mandatory. Text should be used only such cases where it able to eliminate potential information ambiguity.

7.2 Speech

Speech is continuous concept. Speech can introduce, give survey, stimulate and tell. Speech is ideals as an additional explanation of text.

7.3 Graphics

It is a very powerful multimedia component. The real strength of graphics is to maintain context. Graphics are discrete concepts. The user himself determines viewing moments and duration. In this way, graphics are very suitable for individual studying and analyzing of connections. The combination with text is good because both are discrete representations. Graphics approve more interpretation than the image and can be used better for the support of mental model.

7.4 Image

The image is very much related by its photorealistic representation to the concrete contents. Users mood can be influenced by images. In this case, the combination of image with sound will be very much effective.

7.5 Animation

Animation is also a component in multimedia database. It can be defined as the change in the characteristics of an object over a period of time. Animation files require more storage space than graphic files involving single image.

7.6 Sound

Sound as music or speech has a power to invoke emotions. Music can stimulate moods positively in reviving or relaxation of mind and body; whereas sound as noise helps to irritate people. The combination of sound with animation will really have a realistic effect on users.

7.7 Video

Video is the most powerful of all the multimedia components. It helps to portray the real world events. It will also help to grasp the more delicated and complicated situation/ ideas into minds.

8 Structure of multimedia database

Multimedia database structure can best be explained with the following components:

- Data Analysis
- Data Modeling
- Data Storage
- Data Retrieval
- Query Language
- Multimedia Communication

8.1 Data analysis

In data analysis, generally two questions are often asked: How are these data structured? How can these data be accessed? Data can be stored in the database in either unformatted (unstructured) form or formatted (structured) form. Unstructured data are presented in a unit where the content cannot be retrieved by accessing any structured details. Structured data are stored in variables, fields or attributes with corresponding values. Multimedia data can be stored in database as raw, registering and descriptive data types. Raw data are generally represented by the pixels in the form of a bytes and bits. For example, in image can be represented in pixels and to get the image it is essential to know the size of the image.

8.2 Data modeling

Data model deals with the multimedia objects, which has already been explained in the previous section. Data model concentrates on conceptual design of the multimedia database in order to execute certain operations like, media object selection, insertion, querying and retrieval etc. Time-based multimedia like video, audio and animation involve notions of data flow, timing, temporal composition and synchronization. These notions are quite different from conventional data like textual data flow. One of the gravest problems of multimedia database system is the description of the structure of time constraint media for querying, updating, retrieval and presentation.

8.3 Data storage

Multimedia data objects are stored in the database. These are of types- non-continuous media such as static media like text, and images; and continuous media such as dynamic media. Continuous media data has the real time property while non-continuous data has not. Therefore, storage mechanism will be different for these types of data. Most of the continuous media data are stored using separate storage server to meet the real time constraint requirements. Non-continuous data are stored in the database with meta-information about the files. In general, data can be stored either in Hard Disc, CD-ROM, DVD or Online.

A storage server that stores a large number of long multimedia documents must manage huge volume of storage systems that will be constructed in hierarchical fashion using storage device of various types as described earlier.

8.4 Data retrieval

The ultimate objective of any multimedia database is how to access multimedia information effectively. With respect to access, multimedia objects can be classified into two -- active and passive objects. The objects, which participate in the retrieval process, are called active objects. Similarly, the objects, which are not participating in the retrieval process are called passive objects. In a really multimedia database environment all objects should be active objects.

8.5 Query language

In order to retrieve multimedia data from database system, query language is provided to fulfill this purpose. In a DBMS process, user queries are processed by defining a query language as part of DBMS. It is an unseparated part of DBMS. A multimedia query language must have ability to handle complex, spatial, and temporal relationships. A powerful query language should have to deal with keywords, index to keywords and contents of multimedia objects. Traditional DBMS deals with exact match query. Generally, there are two types of queries used in databases. They are well-defined query and fuzzy query. In a well-defined

query, the user must know what they are intended to search. The second one is called fuzzy where the properties of query objects are ambiguous. In such a situation, multimedia data queries can be divided into the sub-groups like keyword querying, semantic querying, and visual querying. Keyword querying is still popular because of its simplicity. Semantic query is the most difficult query method in terms of its indexing and pattern matching. Visual querying is used in QBIC (Query By Image Context) through icon leading to content search in the domain of image.

8.6 Multimedia communication

Communication is the sole objectives of any information system. Distributed Multimedia Systems with sophisticated features are capable of satisfying multi-users environment allowing more than one users to communicate at each other simultaneously.

9 How to create a multimedia database?

There are few steps required to create a Multimedia Database as described below:

Step-1: Take various multimedia elements as described in the previous section-7.

Step-2: Digitize multimedia materials, which are not in digital format acceptable for storing in the computer. Here different file formats are required to be maintained multimedia documents. In the case of music the common file formats are: WAV, MIDI, MP3, AIFF, RA etc. Movie file formats may be of: AVI, MPEG, ASF, QT etc. Similarly, for Sound we know that the common formats are: WAV, MIDI, MP3, RA, ASF, WMA, CDA etc.

Step-3: After that, it is required to classify, catalog and index the digitized multimedia elements. These steps are also the same as in general database but in case of animation or image, the classification is difficult. For example, a multimedia data categorized as a graphic image could be a graphic image containing 256 color, or a graphic containing millions of color.

Step-4: The final step is to input descriptive text pertaining to the multimedia data into the RDBMS (Relational Database Management System). A standard query language like SQL is required to retrieve information from the database.

10 Conclusion

Multimedia database works behind the screen as a backbone support for the integration and presentation of large amount of good quality multimedia data in an effective and efficient manner. In order to get success in communication through multimedia requires synchronization among various multimedia objects and uniformly modeled high storage devices. To implement a multimedia database, we can use relational database model where we can predefined the relation among multimedia objects. Similarly, we can also use the object-oriented database model to provide multimedia services. Finally, multimedia database in network environment will really bring a tremendous revolution in communication in the multimedia environment.

11 Reference

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